



ALBERTA  
OIL SANDS  
INDUSTRY  
QUARTERLY  
UPDATE

SPRING 2010

Reporting on the period: Dec. 12, 2009 to Mar. 5, 2010

Government  
of Alberta

# All about the oil sands

**Background of an important global resource**



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June Warren-Nickle's Energy Group

Alberta has the second-largest deposit of oil in the world—only Saudi Arabia can claim a larger stockpile of crude. But 170 billion barrels of Alberta's 179 billion barrels of oil have the special quality of being bitumen, a resource that has been developed for decades but is only now coming into the forefront of the global energy industry, as conventional supplies—so-called “easy” oil—continue to be depleted. The figure of 170 billion barrels represents what is considered economically recoverable with today's technology, but with new technologies, this reserve estimate could be increased to as much as 315 billion barrels.

There are three major bitumen (or oil sands) deposits in Alberta. The largest is the Athabasca deposit, located in the province's northeast, in the Regional Municipality of Wood Buffalo. The main population centre of the Athabasca deposit is the City of Fort McMurray. The second-largest oil sands deposit is referred to as Cold Lake, just south of Athabasca, with the main population centre the City of Cold Lake. The smallest oil sands deposit is known as Peace River, which is located in northwest central Alberta. A fourth deposit called Wabasca links to the Athabasca and is generally lumped in with that area.

The existence of bitumen in Alberta has been known for a long time. The first mention of it in Canadian history was in 1779, when a Cree named Wapasu brought a sample of the “gum” to a Hudson's Bay trading post. First Nations in what is now the Wood Buffalo area had traditionally used the bitumen, which seeps from outcrops along the Athabasca River, to waterproof their canoes.

Today bitumen is produced as an energy source by two means—mining and in situ. The majority of oil sands production is done by surface mining, but this will likely change in the future

as 80 per cent of Alberta's bitumen deposits are too deep underground to economically employ this technology.

Right now there are essentially two commercial methods of *in situ* (Latin for “in place,” essentially meaning wells are used rather than trucks and shovels). In cyclic steam stimulation (CSS), high-pressure steam is injected into directional wells drilled from pads for a period of time, then the steam is left to soak in the reservoir for a period, melting the bitumen, and then the same wells are switched into production mode, bringing the bitumen to the surface.

In steam-assisted gravity drainage (SAGD), parallel horizontal well pairs are drilled from well pads at the surface. One is drilled near the top of the target reservoir, while the other is drilled near its bottom. Steam is injected into the top well; a steam chamber forms, and via gravity, the melted bitumen flows into the lower well and is pumped to the surface using artificial lift.

Both SAGD and CSS are used in the Cold Lake and Peace River deposits, while SAGD is the *in situ* technology of choice in the Athabasca deposit. The choice is based on a number of things, including geology. The technologies combined currently produce just over one million barrels per day.

Research is underway on a number of other production technologies designed to optimize production and minimize water and energy use, including vapour extraction (VAPEX), and a form of *in situ* combustion known as toe-to-heel air injection (THAI).

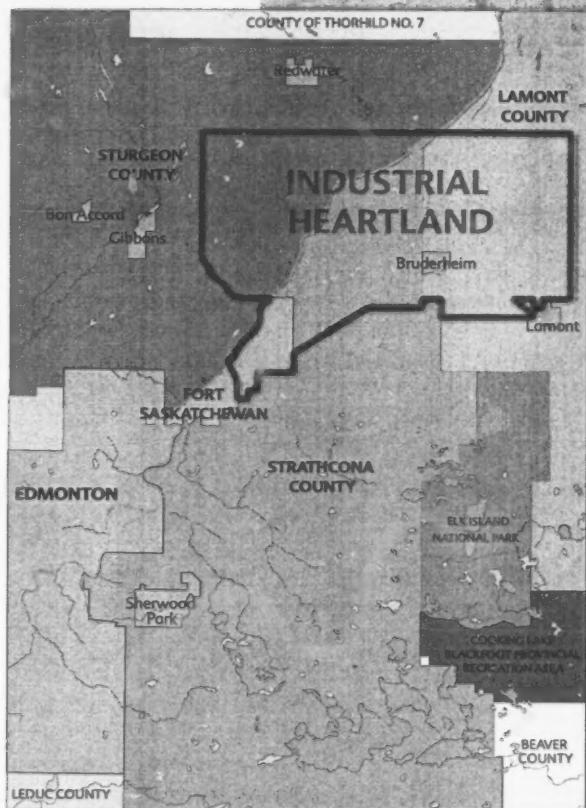
Bitumen that has not been processed, or “upgraded,” can be used directly as asphalt. It must be diluted to travel by pipeline. Adding value, some producers upgrade their product into synthetic crude oil (SCO), which is a refinery feedstock. At these refineries, SCO can be transformed into transportation fuels and other products. ■

100 KILOMETRES  
10 20 30 40 50 60 70 80 90 100

# Mapping the oil sands

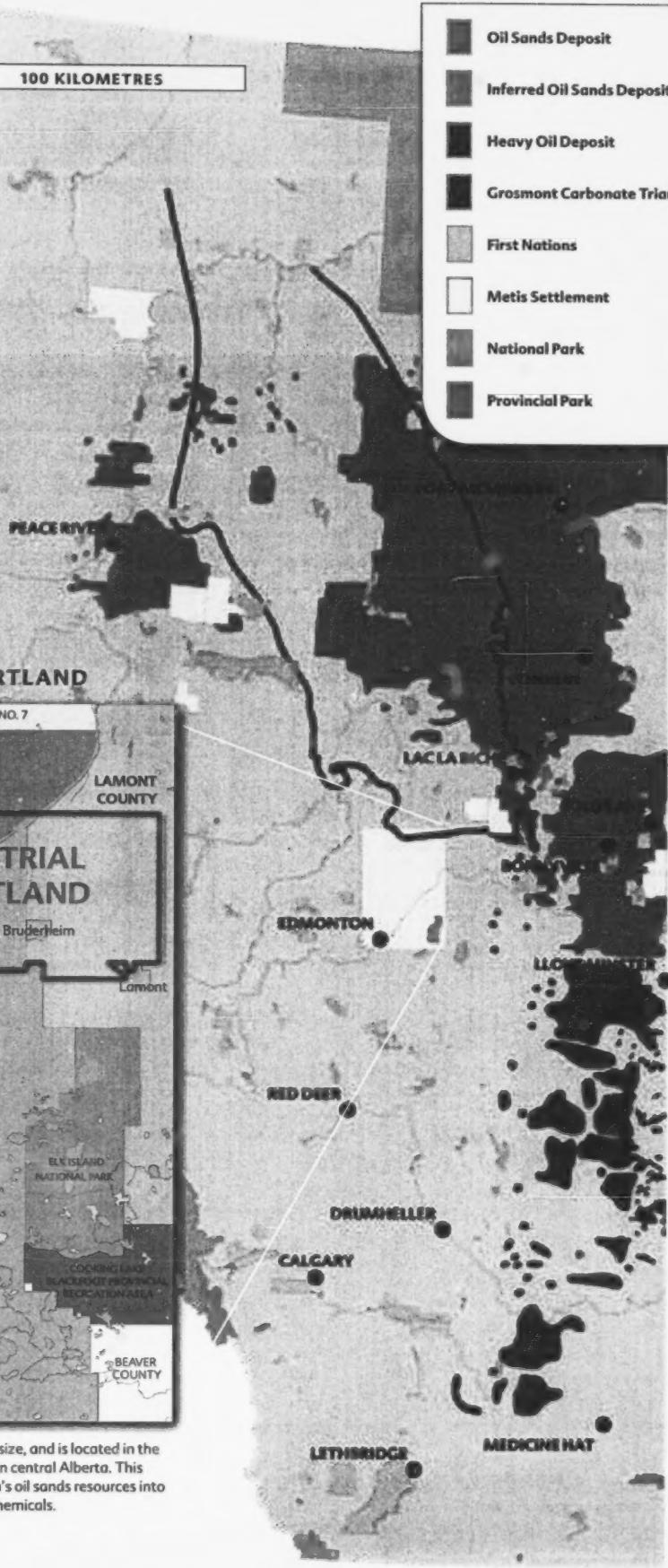
Canada's heavy oil and oil sands resources are often referred to as "the oil that technology made." Without intensive production technology development, the industry would not exist as it does today. These technologies still continue to be advanced and optimized, improving recovery and reducing environmental impacts.

## ALBERTA'S INDUSTRIAL HEARTLAND



Alberta's Industrial Heartland is over 78,550 acres in size, and is located in the northeast quadrant of the Greater Edmonton region in central Alberta. This region is key to the value-added processing of Alberta's oil sands resources into higher valued refined petroleum products and petrochemicals.

- Oil Sands Deposit
- Inferred Oil Sands Deposit
- Heavy Oil Deposit
- Grosmont Carbonate Triangle
- First Nations
- Metis Settlement
- National Park
- Provincial Park



# Government update



## BUDGET 2010

On Feb. 9, 2010, the Government of Alberta released its budget for 2010–11. Within the budget, the province has earmarked \$100 million for carbon capture and storage (CCS). Also, there is \$500 million budgeted over three years to support CCS projects, part of the province's \$2-billion commitment announced in July 2008.

In the newly announced budget, the Government of Alberta will continue to support the implementation of strategies to encourage additional value-added activity in the province and lead the development of government initiatives that encourage the expansion of integrated refining and petrochemical facilities to achieve a broader slate of refined and finished products.

The Alberta government will also work towards the streamlining and rationalization of the natural resource regulatory system and identify improvements that promote environmentally responsible clean energy development.

## NEW GOVERNMENT CABINET

On Jan. 13, 2010, a new cabinet was appointed. With this change, new mandate letters were issued to ministers that focus largely on the additional actions needed to promote continued prosperity within the province and foster the conditions to create a strong foundation for sustainable economic growth.

Ministries have been mandated to work collaboratively to increase the province's economic competitiveness by promoting innovation and value-added economic development to create highly skilled and sustainable jobs for Albertans that encourage economic diversification and strengthen the province's fiscal resiliency.

## COMPETITIVENESS REVIEW

On March 11, the government announced the results of the Competitiveness Review, which contains an extensive technical analysis of Alberta's competitive position.

This review contains a number of recommendations for improvement in specific areas:

- A modification of conventional oil and natural gas royalty rates;
- Steps to ensure improvements to the effectiveness and efficiency of Alberta's regulatory processes while protecting the environment;
- Greater flexibility and support for the use of newer technologies in upstream development; and
- Strengthened productive partnership between Albertans and the resource industry.

In conjunction with this announcement, the government also released its response document, *Energizing Investment*, stating its intention to make adjustments within the fiscal framework, improve the provincial regulatory regime, and drive innovation.

For more information, please visit the Alberta Energy website: [www.energy.alberta.ca](http://www.energy.alberta.ca).

## ALBERTA COMPETITIVENESS ACT (BILL 1)

Through Bill 1, the province will work closely with industry, business leaders, and Albertans towards a shared goal of making the province one of the most competitive jurisdictions in the world. This landmark legislation focuses efforts to ensure Alberta increases its competitive advantage in the face of increasing competition for investment and related employment opportunities from other jurisdictions in a post-recession economy.

Bill 1 will increase collaboration between government, businesses, and Albertans. It will establish a partnership, led by the Premier, and comprised of relevant ministers and key stakeholders. By coordinating efforts to advance shared goals, the partners will develop strategies to enhance Alberta's competitiveness for the long-term benefit of Albertans.

## GOVERNMENT POLICY AND ACTION

### Bitumen royalty in kind (BRIK)

On Oct. 19, 2009, the province issued a request for proposals (RFP) for interested parties to process a share of the Crown's royalty share of bitumen within Alberta. BRIK is designed to take the Crown's share of bitumen royalty in physical barrels to meet oil sands royalty obligations in lieu of cash. The program

initially applies to non-integrated projects (without an Alberta-based upgrader).

Proposals were accepted until Jan. 27, 2010, and are now being evaluated by a cross-ministry committee. This committee will provide recommendations, with input from a Deputy Minister's Advisory Group, to the Minister of Energy for decision on a short list of proposals for negotiation purposes. A decision is currently expected around the end of May 2010.

#### Municipal Climate Change Action Centre

On Feb. 11, 2010, the Government of Alberta announced a one-stop action centre to be located in Edmonton to help Alberta municipalities save energy and money, while advancing Alberta's efforts to address climate change. The Municipal Climate Change Action Centre will provide technical assistance and expertise to municipalities as they work to increase energy efficiencies and improve community-wide energy conservation. The centre will be established with the help of a \$2-million grant from the Government of Alberta to the Alberta Urban Municipalities Association and the Alberta Association of Municipal Districts and Counties.

#### Clean energy research partnership

The Government of Alberta allocated \$25 million towards a research partnership between the University of Alberta and the Helmholtz Association of German Research Centres on Dec. 2, 2009. The grant will be used by the institution to focus on cleaner energy production, advanced reclamation methods, and greenhouse gas reduction technologies, with an emphasis on the oil sands.

#### Productivity Alberta launch

On Jan. 10, Productivity Alberta launched its new web portal for business and industry. The website [www.productivityalberta.ca](http://www.productivityalberta.ca) is a central point of contact to obtain tools, resources, and services to improve business and employee productivity.

#### Productivity Alberta offers:

- An online productivity assessment tool;
- Onsite productivity assessments;
- Information on leading productivity practices;
- Events, seminars, and training;

- Access to productivity experts and advisors; and
- Connections with like-minded businesses.

#### Agreement with United Arab Emirates

Premier Ed Stelmach visited the United Arab Emirates (UAE) from Jan. 16–21 to attend the World Future Energy Summit. The four-day summit in Abu Dhabi is one of the world's leading conferences on sustainable energy development and clean energy solutions. Premier Stelmach's mission focused on increasing Alberta's presence in the UAE and meeting with world leaders, policy-makers, and renewable energy experts.

Premier Stelmach capped off his mission to the UAE with the signing of a Memorandum of Understanding on economic cooperation with the government of Abu Dhabi. The agreement commits Alberta and Abu Dhabi to share information on CCS technologies and policies, support projects of mutual interest, and explore opportunities for collaboration between public and private partners in both jurisdictions.

#### Minister Knight in United States for Energy Conference

Sustainable Resource Development Minister Mel Knight promoted Alberta's competitive investment edge and responsible resource production at a conference of government energy leaders in Washington, D.C. Minister Knight attended the Energy Council's 2010 Federal Energy and Environmental Matters conference on March 4–6 and met with the Pacific Northwest Economic Region leadership in Washington, D.C.

## Upcoming events

Water Technologies Symposium 2010—  
WaterTech 2010  
April 21–23, 2010, Banff, Alberta



# What's new in the oil sands

## Key updates from spring 2010



**Suncor Energy** is assessing damage following a fire at one of the company's two oil sands upgraders north of Fort McMurray, Alberta.

The fire occurred at approximately 10 a.m. Dec. 15 and was extinguished within an hour. There were no injuries and no environmental impacts related to the incident. Appropriate authorities and regulators have been informed.

Preliminary reports showed no structural damage to the facility and the company currently expects repairs to take between two and four weeks. During the repair period, production is expected to be reduced by approximately 120,000 to 150,000 barrels per day.

Suncor does not expect the incident to impact its 2009 production outlook of between 290,000 and 305,000 barrels per day.

**Connacher Oil and Gas** is making significant progress at its Algar steam assisted gravity drainage (SAGD) project, part of its Great Divide in situ operation in northeastern Alberta.

The company says that in its view, the 10,000-barrel-per-day project is now more than 75 per cent complete, and it remains committed to its completion target of April 2010.

Construction activity was reinstated last July after Connacher temporarily suspended work early in the year at the time of the collapse in commodity markets and the crisis in financial markets.

**Enbridge** now intends to file an application for its proposed 525,000-barrel-per-day Northern Gateway oil pipeline to the West Coast in the first quarter of 2010.

The company originally had planned to file its application with the National Energy Board in the fourth quarter of 2009 but was waiting for the final terms of reference from the Joint Review Panel, which will conduct the environmental review of the project, says Enbridge president and chief executive officer Pat Daniel.

"There is a very strong level of interest in Gateway.... We are getting a lot of encouragement to proceed," he says. The 36-inch pipeline would transport Alberta oil sands production to a terminal at Kitimat, British Columbia, where it would be loaded onto very large crude carriers for shipment to Asian or West Coast markets. A second smaller pipeline would transport 193,000 barrels per day of imported condensate from Kitimat to Edmonton.

**Sunshine Oilsands'** application for a small in situ pilot program in the Athabasca region carbonates has been approved by the Energy Resources Conservation Board.

The private, Calgary-based junior had requested approval to conduct a small-scale, under-1,000-barrel-

per-day, single-well cyclical steam stimulation pilot in the Harper area of Alberta. The nearest urban centre, Chipewyan Lake, is approximately 42 kilometres southwest of the proposed pilot location, which has winter-only access.

**Air Products** has announced it has received approval for a new hydrogen pipeline in Alberta's Industrial Heartland that will connect its two existing production facilities with upgraders, refineries, chemical processors, and other industries.

"Hydrogen is a major feedstock for bitumen upgrading and refining, and is key to enabling the production of cleaner-burning transportation fuels," says Steve Losby, general manager, Canada at Air Products. "We expect to make several customer supply announcements in the coming months."

The pipeline is expected to be on stream in 2010.

**Houston-based ConocoPhillips Company** and Paris-based **Total S.A.** are proceeding with an 83,000-barrel-per-day expansion of their 50-50 thermal oil joint venture at Surmont in northeastern Alberta.

ConocoPhillips doesn't release project cost estimates. Work to be done this year will include some Surmont 2 site clearing, ordering some long-lead equipment, and focusing on finalizing the engineering, says Matt Fox, president of ConocoPhillips Canada.

Most of the construction work will occur during 2011 through 2014. An exact figure wasn't immediately available, but Fox said roughly 100 SAGD well pairs will be drilled to achieve annual average output of 83,000 barrels of bitumen per day, which would be reached "a few years" after the project comes on stream.

"We expect we will start operations in 2014. And then first production will be early in 2015 or late 2014," says Fox.

**Alberta Oilsands** has submitted its application for the Clearwater West low pressure SAGD pilot project application to the Energy Resources Conservation Board and Alberta Environment for approval.

The project is located a couple of kilometres southeast of the Fort McMurray Regional Airport, with design production capacity of 4,500 barrels per day of bitumen, coming from six horizontal well pairs. The "stacked" well pair configuration comprises two layers of three parallel horizontal well pairs each, one layer located near the base of the McMurray formation and the second layer located approximately halfway in the depth of the reservoir.

A low-pressure solvent co-injection scheme is planned for the lower layer of wells. The upper layer of wells is intended to have low-pressure steam injection only with the potential application of electro-magnetic heating technology.

**Cenovus Energy** says the expansions of its 50 per cent owned oil sands projects at Christina Lake and Foster Creek in northeastern Alberta are still proceeding as planned.

The company plans to spend US\$2 billion to US\$2.3 billion this year on increased development at Foster Creek/Christina Lake to improve production by 15 to 20 per cent and at the continuing expansion of the 50 per

cent owned Wood River refinery in Illinois where some of the bitumen is processed.

The thermal oil projects, now producing a total of more than 115,000 barrels of bitumen per day before royalties (50 per cent net to Cenovus and 50 cent net to ConocoPhillips, which also owns the other half of Wood River), are expected to produce more than 400,000 barrels per day when fully developed.

Foster Creek is currently producing 100,000 barrels per day and is slated to boost output to 210,000 barrels per day by 2017.

"It's on schedule, on cost, and the ramp-up occurred just as predicted," says Harbir Chhina, executive vice-president, enhanced oil development and new resource plays.

At Christina Lake, Phase C is expected to add about 40,000 barrels per day of capacity, with first production forecast in late 2011.

**Royal Dutch Shell** says it is not bowing to pressure from environmentalists and its own shareholders in its decision to slow oil sands spending now that the expansion of its Athabasca Oil Sands Project is nearly complete.

Cutting back on spending is all part of the company's previously announced plan, says Peter Voser, Shell's chief executive officer.

"We take the challenge, we work the issue, we want to perform in a sustainable way, and we have...made progress. I think on the advocacy of the oil sands let's also have the facts on the table, and that's what we will do with our shareholders."

Shell's aim now is to get the expansion on stream and then take full advantage of it, he says.

"This is not a big shift in strategy, but it's quite clearly something which we outlined a long time ago, some 12 months ago, and we are following through, but we are watching the market. We made it very clear already 12 months ago that we will watch the cost situation carefully in the oil sands environment before we take another major expansion step forward."

**Statoil Canada** has signed an initial 10-year agreement with Enbridge, which will provide transportation service on its regional oil sands system for up to 30,000 barrels per day from Statoil's Leismer project.

Leismer will be the sixth producing oil sands project connecting to Enbridge's regional system, is in close proximity to the Waupisoo Pipeline, one of two large-diameter pipelines comprising the regional system that delivers oil sands crude to the mainline hubs at Edmonton and Hardisty. Total production from the four Statoil project leases is expected to eventually reach 220,000 barrels of bitumen per day. First oil from Leismer is expected in late 2011.

**The Canadian oil sands** can expect to see more Chinese investment following federal government signals that Canada is open for business with China, perhaps especially in the energy sector.

"China's investment in the oil sands and energy sector and mining sector in Canada is about to take off even more significantly than it has in the last number of

years," says Peter Harder, president of the Canada-China Business Council. "There is no doubt that China needs and wants energy."

The council, the oldest and best-established foreign trade association in modern China, has called for Canada to remove the regulatory barriers that discouraged Chinese investment in the oil sands.

"We made it quite clear that we believe unfettered Chinese investment in Canada's energy sector is good for Canada and good for global trade."

**In situ upgrading** will be the focus of a new research facility consisting of nine "mini-refineries" at the University of Calgary, which was officially opened in February.

The bench-scale pilots done there will enable Dr. Pedro Pereira Almão, director of the In Situ Energy Centre and professor in the university's Schulich School of Engineering, and his team to test and optimize the best catalyst and upgrading process, in terms of efficient bitumen recovery, cost-effectiveness, and environmental impact.

**An updated version** of the rules surrounding reserves evaluation will contain welcome guidelines for evaluation and classification of bitumen and should hopefully result in more consistency, says a reserves evaluator.

There should be less uncertainty about whether a particular bitumen accumulation qualifies for reserves, resources, or neither, says Phil Welch, president and managing director of McDaniel & Associates Consultants.

The fact that oil sands reserves and more particularly resources are being used as the basis for significant industry transactions has placed a particular onus on the quality and consistency of these types of reports, he says.

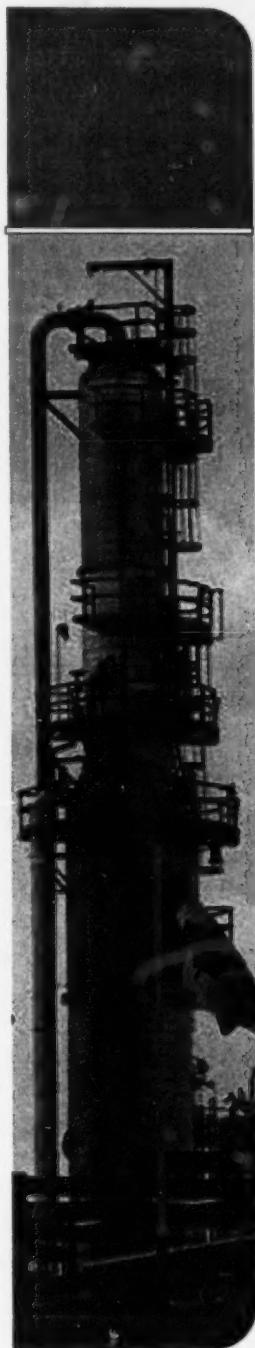
The new section of the *Canadian Oil and Gas Evaluation Handbook* (COGEH), which is currently under review, will feature an introduction of the term "exploitable bitumen-in-place," which is the portion of bitumen accumulation deemed to be potentially exploitable using certain criteria. It is not currently a recognized COGEH term.

Welch says it is expected that EBIP will be routinely used and disclosed in reports and for public disclosure when accompanied by detailed explanation of cut-offs used.

**Fining International** says its Canadian division has been chosen by Imperial Oil as a mining mobile equipment supplier for the Kearl oil sands project. The 10-year agreement includes the supply of Caterpillar equipment, parts, specialized maintenance labour, and training.

**Convinced that innovation and the application of technology** are the keys to profitable and sustainable oil sands development, **Petroleum Technology Alliance Canada** has formed a consortium it is calling the Clean Bitumen Technology Action Plan. The group is comprised of 26 oil sands stakeholders from industry and government, including experts from technical and environmental disciplines.

The plan will unfold over 12 months as a schedule of workshops and topical reports are drawn up, culminating in a document that will serve as an action plan for technology development and foundation for future policy, strategy, and investment decisions. ■



# Project listings

## Updated status of oil sands projects in Alberta

As of March 22, 2010.

TECHNOLOGY	
CODG	Conduction-oriented gravity drainage
CSS	Cache steam stimulation
ECDP	Electro-chemical dynamic steaming process
ESCO	Electro-chemical solvent injection
SAGD	Steam-assisted gravity drainage
TIAE	Turbine heat exchangers

COMPANY	CURRENT PROJECT	CAPACITY (MMBD)	REGULATORY STATUS	DEVELOPMENT PROGRESS	TECHNOLOGY
<b>ATHABASCA REGION – IN SITU</b>					
<b>ALBERTA OIL SANDS</b>					
Clearwater	Pilot	4,500	TBD	Application	SAGD
	Commercial Project	10,000	TBD	Announced	SAGD
<b>ATHABASCA OIL SANDS</b>					
Dove	Pilot	2,000	TBD	Application	SAGD
	Pilot	2,200	TBD	Application	SAGD
	Phase 1	35,000	TBD	Announced	SAGD
MacKay River	Phase 2	40,000	TBD	Application	SAGD
	Phase 3	40,000	TBD	Application	SAGD
	Phase 4	35,000	TBD	Application	SAGD
<b>BLACKPEARL RESOURCES</b>					
Blackrod	Pilot	600	TBD	Application	SAGD
<b>CANADIAN NATURAL RESOURCES</b>					
Birch Mountain East	Phase 1	60,000	2016	Announced	TBA
Gregoire Lake 1	Phase 1	60,000	2018	Announced	TBA
Grouse	Phase 1	60,000	2014	Announced	TBA
Kirby	Phase 1	45,000	2012	Application	SAGD
Lansmer	Phase 1	30,000	2018	Announced	TBA
<b>CENOVUS ENERGY</b>					
Borealis	Phase A	35,000	TBD	Application	SAGD
	Phase B	32,500	TBD	Announced	SAGD
	Phase C	32,500	TBD	Announced	SAGD
Christina Lake	Phase 1A	10,000	2002	Operating	SAGD
	Phase 1B	8,800	2008	Operating	SAGD
	Phase 1C	40,000	2011	Construction	SAGD
	Phase 1D	40,000	2013	Approved	SAGD
	Phase 1E	40,000	TBD	Announced	SAGD
Norwells Lake	Phase 1F	40,000	TBD	Announced	SAGD
	Phase 1G	40,000	TBD	Announced	SAGD
	Phase A	40,000	TBD	Announced	SAGD
	Phase B	80,000	TBD	Announced	SAGD
	Phase 1A	24,000	2001	Operating	SAGD
Foster Creek	Debottlenecking	6,000	2003	Operating	SAGD
	Phase 1C – Stage 1	10,000	2005	Operating	SAGD
	Phase 1C – Stage 2	20,000	2007	Operating	SAGD
	Phase 1D	30,000	2009	Operating	SAGD
	Phase 1E	30,000	2009	Operating	SAGD
Chevron Canada	Phase 1F	30,000	2016	Application	SAGD
	Phase 1G	30,000	2017	Application	SAGD
	Phase TH	30,000	TBD	Application	SAGD
	Ells River	100,000	TBD	Announced	TBA

COMPANY	CURRENT PROJECT	CAPACITY (MMBO)	START-UP	REGULATORY STATUS	DEVELOPMENT PROGRESS	TECHNOLOGY
<b>COINNACHER OIL AND GAS</b>						
Great Divide	Pod 1	10,000	2007	Operating	Construction continues in a "most favourable manner." Commissioning anticipated in mid-April.	SAGD
	Pod 2 (Algash)	10,000	2010	Under construction		SAGD
	Expansion	24,000	2012	Disclosed		SAGD
<b>CONOCOPHILLIPS CANADA</b>						
Surmont	Phase 1	27,000	2008	Operating	Plant continues to ramp up to full capacity. ConocoPhillips and 50/50 joint venture partner Total have sanctioned Surmont Phase 2.	SAGD
	Phase 2	83,000	2014 - 2016	Under construction		SAGD
	Pilot	1,200	1997	Operating		SAGD
<b>DEVON CANADA</b>						
Jackfish	Phase 1	35,000	2007	Operating	In late 2009, Jackfish 1 was producing approximately 33,000 barrels per day, closing in on facility capacity. Devon reports construction continues on schedule and under budget. Jackfish 3 regulatory application to be filed in 2010.	SAGD
	Phase 2	35,000	2011	Under construction		SAGD
	Phase 3	35,000	TBD	Announced		SAGD
<b>ENERPLUS RESOURCES</b>						
K's-by	Phase 1	10,000	TBD	Application	Enerplus says while it sees value in the project and it continues to move through regulatory process, minimal spending will occur in 2010.	SAGD
	Phase 2	25,000	TBD	Announced		SAGD
<b>E-T ENERGY</b>						
Poplar Creek	Pilot	1,000	2007	Operating	Extended field test of ET-DSP electric production technology continues.	ET-DSP
		10,000	2011	Application		
<b>EXCELSIOR ENERGY</b>						
Hangingstone	Phase 1	1,000	2011	Application	Excelsior Energy has exercised its option to acquire and cancel the gross overriding royalty that currently encumbers the project.	COGD
<b>GRIZZLY OIL SANDS</b>						
Algash Lake		10,000	TBD	Application	Application filed March 2010.	SAGD
<b>HUSKY ENERGY</b>						
McMullen	Pilot	755	TBD	Application	Front-end engineering and design complete. Husky is preparing to issue RFPs for central plant and field facilities. First five well pairs are being built. Corporate sanction anticipated in the near term, with detailed engineering and construction to begin in the second half of this year.	SAGD
	Phase 1	60,000	2014	Approved		SAGD
	Phases 2-3	140,000	TBD	Approved		SAGD
<b>IVANHOE ENERGY</b>						
Tomrock	SAGD with HTL upgrading	20,000	2014	Announced	Ivanhoe has surpassed the halfway mark in its current delineation program at Tomrock. A regulatory application is anticipated in 2010.	SAGD
<b>JAPAN CANADA OIL SANDS</b>						
Hangingstone	Pilot	10,000	1999	Operating	Preparing regulatory application and conducting EIA.	SAGD
	Phase 1	35,000	TBD	Disclosed		SAGD
<b>KOREA NATIONAL OIL CORPORATION</b>						
BlockGold	Phase 1	10,000	2012	Approved	Phase 1 approved January 2010. Reports are that KNOC is looking to pick up more oil sands assets.	SAGD
	Phase 2	20,000	TBD	Announced		SAGD
<b>LARICINA ENERGY</b>						
Cormorant	SAGD pilot	1,800	TBD	Approved	Laricina reports the pilot is "development ready."	SAGD
	Phase 1	10,000	TBD	Announced		SAGD
Sawdust	Carbonate SAGD demonstration	1,800	2010	Under construction	Two horizontal well pairs to be drilled this winter.	SAGD
	Phase 1	10,000	TBD	Announced		SAGD
<b>MEG ENERGY</b>						
Christina Lake	Phase 1	3,000	2008	Operating	Commissioning underway.	SAGD
	Phase 2	22,000	2009	Operating		SAGD
	Phase 2B	15,000	TBD	Approved		SAGD
	Phase 3A	75,000	TBD	Application		SAGD
	Phase 3B	75,000	TBD	Application		SAGD
<b>NEXEN</b>						
Long Lake	Phase 1	72,000	2007	Operating	Steam debottleneck project completed. Electric submersible pumps continue to be installed in a number of wells. Approximately 42 well pairs currently have ESPs, with 39 well pairs currently on production. Partner Opti expects the project will be at or near design rates later than previous guidance of late 2010. Nexen says it wants more ramp-up from Phase 1 and stronger economic conditions before deciding to sanction Phase 2.	SAGD
	Phase 2	72,000	TBD	Announced		SAGD
	Phase 3	72,000	TBD	Announced		SAGD
	Phase 4	72,000	TBD	Announced		SAGD

COMPANY	CURRENT PROJECT	CAPACITY (MMbbl)	REGULATORY STATUS	DEVELOPMENT PROGRESS	TECHNOLOGY
Long Lake South	Phase 1	70,000	TBD	Approved	SAGD
	Phase 2	70,000	TBD	Approved	SAGD
N-SOLV	Pilot plant	2,000	TBD	Announced	N-SOLV
PATCH INTERNATIONAL					
Els River		10,000	TBD	Announced	SAGD
<b>PETROBANK ENERGY AND RESOURCES</b>					
Whitesands	Pilot	1,800	2006	Operating	THAI
	Expansion	1,800	TBD	Approved	THAI
May River	Phase 1	10,000	TBD	Application	THAI
	Subsequent Phases	90,000	TBD	Disclosed	THAI
<b>SOUTHERN PACIFIC RESOURCE</b>					
STP-McKay		12,000	2012	Application	SAGD
<b>STATOIL CANADA</b>					
Kai Kos Dahsah-Leismer	Demonstration	10,000	2010	Under construction	SAGD
	Commercial	10,000	TBD	Application	SAGD
Leismer	Expansion	20,000	TBD	Application	SAGD
	Corner	40,000	TBD	Application	SAGD
Thombury	Corner	40,000	TBD	Application	SAGD
	Expansion	40,000	TBD	Application	SAGD
Hangingstone	Corner	40,000	TBD	Application	SAGD
	Hangingstone	20,000	TBD	Application	SAGD
Thombury	Expansion	20,000	TBD	Application	SAGD
	Northwest Leismer	20,000	TBD	Application	SAGD
South Leismer	South Leismer	20,000	TBD	Application	SAGD
	Wopisico Pipeline				
<b>SUNCOR ENERGY</b>					
Chand	Phase 1	40,000	TBD	Announced	SAGD
	Phase 1	33,000	2004	Operating	SAGD
Firebag	Phase 2	35,000	2006	Operating	SAGD
	Cogeneration and Expansion	25,000	2007	Operating	SAGD
Firebag	Phase 3	68,000	2011	Under construction	SAGD
	Phase 4	68,000	2012	Under construction	SAGD
Lewis	Phase 5	68,000	TBD	Approved	SAGD
	Phase 6	68,000	TBD	Approved	SAGD
Lewis	Phase 1	40,000	TBD	Application	SAGD
	Phase 2	40,000	TBD	Application	SAGD
MacKay River	Phase 1	33,000	2002	Operating	SAGD
	Phase 2	40,000	TBD	Approved	SAGD
Meadow Creek	Phase 1	40,000	TBD	Approved	SAGD
	Phase 2	40,000	TBD	Approved	SAGD
<b>SUNSHINE OIL SANDS</b>					
Harper pilot	Production mobility test	<1,000	TBD	Approved	SAGD
	Phase 1	10,000	TBD	Announced	SAGD
Legend Lake	Phase 2 (two stages)	40,000	TBD	Announced	SAGD
	Phase 1	10,000	TBD	Announced	SAGD
West Ells	Phase 2 (two stages)	40,000	TBD	Announced	SAGD
	Phase 3	30,000	TBD	Announced	SAGD
Thickwood	Phase 1	10,000	TBD	Announced	SAGD
	Phase 2 (two stages)	40,000	TBD	Announced	SAGD
Thickwood	Phase 3	25,000	TBD	Announced	SAGD

COMPANY	CURRENT PROJECT	CAPACITY (MMb/d)	DATE	REGULATORY STATUS	DEVELOPMENT PROGRESS	TECHNOLOGY	
<b>TOTAL E&amp;P CANADA</b>							
Joslyn	Phase 1	2,000	2004	Suspended	The ERCB has released its long-awaited report into the steam release that occurred at Joslyn in May 2006. Total plans to abandon the in situ portion of the Joslyn project.	SAGD	
	Phase 2	10,000	2006	Suspended		SAGD	
	Phase 3A	15,000	TBD	Withdrawn		SAGD	
	Phase 3B	15,000	TBD	Withdrawn		SAGD	
<b>VALUE CREATION GROUP</b>							
Terre de Grace	Pilot	10,000	TBD	Application	BP will become majority partner and operator of the Terre de Grace project.	SAGD	
	Phase 1	40,000	TBD	Announced		SAGD	
	Phase 2	40,000	TBD	Announced		SAGD	
<b>ATHABASCA REGION – MINING</b>							
<b>ATHABASCA OIL SANDS PROJECT</b>							
Jockpine	Phase 1A	100,000	2010/2011	Under construction	Project partner Marathon Oil reports Expansion 1 is on track and anticipated to begin mining operations in the second half of 2010, and upgrader operations in late 2010 or early 2011. Shell is reportedly going to slow down its investment in Alberta's oil sands in favour of less costly conventional sources.	Mining	
	Phase 1B	100,000	TBD	Approved		Mining	
	Phase 2	100,000	TBD	Application		Mining	
Muskeg River	Existing Facilities	155,000	2002	Operating	Final investment decision delayed.	Mining	
	Expansion and Debottlenecking	115,000	TBD	Approved		Mining	
Pierre River	Phase 1	100,000	TBD	Application		Mining	
	Phase 2	100,000	TBD	Application		Mining	
<b>CANADIAN NATURAL RESOURCES</b>							
Horizon	Phase 1	110,000	2009	Operating	Canadian Natural targets sustained production at capacity in mid-2010. Canadian Natural hopes to sanction Tranche 2 by the end of 2010. Tranches 3 and 4 continue to be re-profiled based on learnings from Phase 1.	Mining	
	Tranche 2	6,000-15,000	TBD	Approved		Mining	
	Tranche 3	10,000-20,000 approx. 105,000	TBD	Approved		Mining	
	Tranche 4	105,000	TBD	Approved		Mining	
<b>IMPERIAL OIL</b>							
Kear	Phase 1	110,000	2012	Under construction	Infrastructure construction and plant site preparation continues, with a workforce of about 2,500 people at year-end 2009.	Mining	
	Phase 2	100,000	TBD	Approved		Mining	
	Phase 3	100,000	TBD	Approved		Mining	
<b>SUNCOR ENERGY</b>							
Fort Hills	Phase 1	165,000	TBD	Approved	Capital plans and sequencing for Suncor's next growth stages are under evaluation with a further update to be expected in Q4-2010.	Mining	
	Debottlenecking	25,000	TBD	Approved		Mining	
Suncor – original operations	Millennium	294,000	1967	Operating	North Steepbank extraction plant completed within schedule and revised budget in September 2009. It is expected to improve reliability and productivity.	Mining	
	Steepbank Debottleneck Phase 3	4,000	2007	Operating		Mining	
	Millennium Debottleneck	23,000	2008	Operating		Mining	
	North Steepbank Extension		2010	Operating		Mining	
Voyageur South	Phase 1	120,000	TBD	Application		Mining	
<b>SYNCRUDE (MILDRED LAKE AND AURORA)</b>							
Syncrude – original operations	Stages 1 and 2	290,700	1978	Operating	Syncrude plans to increase production by constructing two 100,000-barrel-per-day mine trains at Aurora and accessing latent upgrading capacity. First new production is anticipated in 2016. Construction is slated to begin in 2012.	Mining	
	Stage 3 Expansion	116,300	2006	Operating		Mining	
	Stage 3 Debottleneck	46,500	TBD	Announced		Mining	
	Stage 4 Expansion	139,500	TBD	Announced		Mining	
<b>TOTAL E&amp;P CANADA</b>							
Joslyn	Phase 1 (North)	50,000	TBD	Application	Total's application continues to wind through the regulatory process.	Mining	
	Phase 2 (North)	50,000	TBD	Application		Mining	
	Phase 3 (South)	50,000	TBD	Announced		Mining	
	Phase 4 (South)	50,000	TBD	Announced		Mining	
Northern Lights	Phase 1	57,250	TBD	Withdrawn	Northern Lights asset is being integrated into Total portfolio. Will reinstate after new timing is determined.	Mining	
	Phase 2	57,250	TBD	Withdrawn		Mining	

COMPANY	CURRENT PROJECT	CAPACITY (bbl/d)	LAUNCH YEAR	REGULATORY STATUS	DEVELOPMENT PROGRESS	TECHNOLOGY
<b>UTS/TECK RESOURCES</b>						
Equinox		50,000	TBD	Disclosed	Draft design basis memorandum engineering study is under review by partners, but will not be finalized until potential to develop the project as a satellite bitumen froth production facility to Frontline has been evaluated.	Mining
Frontier	Phase 1	100,000	TBD	Disclosed	Preliminary mine planning and conceptual designs for mine and extraction facility complete. UTS intends to move forward with a design basis memorandum and associated field work early in 2010, preparing an application for early 2011.	Mining
	Phase 2	60,000	TBD	Disclosed		Mining
<b>COLD LAKE REGION – IN SITU</b>						
<b>BR OIL SANDS (SHELL)</b>						
Orion	Phase 1	10,000	2008	Operating	Production averaged 2,365 barrels per day in November 2009.	SAGD
	Phase 2	10,000	TBD	Approved	Shell is reportedly slowing its oilsands investments in favour of less costly conventional resources.	SAGD
<b>CANADIAN NATURAL RESOURCES</b>						
Primrose/Wolf Lake	Wolf Lake	13,000	1985	Operating		CSS
	Wolf Lake SAGD	5,500	TBC	Application		SAGD
	Primrose South	45,000	1985	Operating		CSS
	Primrose North	30,000	2006	Operating		CSS
	Primrose East (Burnt Lake)	32,000	2009	Operating	Canadian Natural is proceeding with diagnostic steaming relating to oil seepage upon start-up. Targets production of between 16,000 to 22,000 barrels per day in 2010.	CSS
	CSS Follow-up Process	25,000	2018	Application		CSS
<b>HUSKY ENERGY</b>						
Caribou	Demonstration Project	10,000	TBD	Approved		SAGD
Tucker	Phase 1	30,000	2006	Operating	Husky is optimizing Tucker to ramp up production, reporting some wells are now performing according to plan.	SAGD
<b>IMPERIAL OIL</b>						
Cold Lake	Phases 1-10: Leming, Maskwa, Mahikan	110,000	1985	Operating		CSS
	Phases 11-13: Mohkese	30,000	2003	Operating		CSS
	Phases 14-16: Nobyle, Mahikan North	30,000	TBD	Approved	Production decreased in the final months of 2009 due to well repairs in the northern part of the field. Imperial reports drilling and steaming has resumed and production is expected to return to normal levels.	CSS
<b>KOCH EXPLORATION CANADA</b>						
Gemini	Pilot	1,200	TBD	Application		SAGD
	SAGD Project	10,000	TBD	Application	Permit application filed on June 15, 2009. Koch is performing detailed engineering work and public consultation continues.	SAGD
<b>OSUM OIL SANDS</b>						
Togo	SAGD/CSS Project	25,000-35,000	2014	Application	Application filed January 2010.	SAGD
<b>PENGROWTH ENERGY TRUST</b>						
Lindbergh	SAGD Pilot	2,500	TBD	Application	Approval anticipated in 2010. Pengrowth will spend \$15 million on project in 2010.	SAGD
<b>PEACE RIVER REGION – IN SITU</b>						
<b>ANDORA ENERGY (PAN ORIENT)</b>						
Sawn Lake	SAGD Demonstration	1,400	TBD	Approved	Timing for equipment procurement and project drilling and construction TBD.	SAGD
<b>NORTH PEACE ENERGY</b>						
Red Earth	CSS Pilot	1,000	2008	Operating		CSS
	Expansion	3,000	TBD	Announced		CSS
	Commercial Project	10,000	TBD	Announced	North Peace has initiated a process to explore strategic alternatives to enhance shareholder value. Could include a sale or merger.	CSS
<b>SHELL CANADA</b>						
Carmen Creek	Cadotte Lake	12,501	1986	Operating		CSS
	Phases 1 and 2	80,000	TBD	Announced	New application filed January 2010. Shell expects construction of first 40,000-barrel-per-day plant to commence in 2011, with a second 40,000-barrel-per-day facility three years following.	CSS
<b>NORTHWEST SASKATCHEWAN – IN SITU</b>						
<b>OILSANDS QUEST</b>						
Axe Lake	Reservoir Test	600	2008	Operating		
	In Situ Program	10,000	TBD	Announced	CEO Christopher Hopkins has resigned to lead a new oil shale company ConShale. Oilsands Quest executive chairman T. Murray Wilson to take on vacated role.	

COMPANY	CURRENT PROJECT	CAPACITY (MM/D)	YEAR	REGULATORY STATUS	DEVELOPMENT PROGRESS	TECHNOLOGY	
<b>ATHABASCA REGION – UPGRADING</b>							
<b>CANADIAN NATURAL RESOURCES</b>							
Horizon	Phase 1	135,000	2008	Operating	Canadian Natural targets sustained production at capacity in mid-2010. Canadian Natural hopes to sanction Tranche 2 by the end of 2010. Tranches 3 and 4 continue to be re-profiled based on learnings from Phase 1.	Upgrader	
	Tranche 2 & 3	135,000	TBD	Approved		Upgrader	
	Tranche 4	145,000	TBD	Announced		Upgrader	
<b>NEXEN</b>							
Long Lake	Phase 1	72,000	2008	Operating	Project partner Opti says upgrader uptime has increased significantly, and that premium sweet crude yields are increasing.	Upgrader	
	Phase 2	72,000	TBD	Approved		Upgrader	
	Phase 3	72,000	TBD	Announced		Upgrader	
	Phase 4	72,000	TBD	Announced		Upgrader	
	Phase 5	72,000	TBD	Announced		Upgrader	
	Phase 6	72,000	TBD	Announced		Upgrader	
<b>SUNCOR ENERGY</b>							
Suncor – original operations	Base U1 and U2	281,000	1967	Operating	Capital plans and sequencing for the next stages of Suncor's growth to be announced in Q4-2010.	Upgrader	
	Millennium Vacuum Unit	43,000	2005	Operating		Upgrader	
	Millennium Coker Unit	116,000	2008	Operating		Upgrader	
Voyager	Phase 1	156,000	TBD	Suspended	Syncrude plans to increase production by constructing two 100,000-barrel-per-day mine trains at Aurora and accessing latent upgrading capacity. First new production is anticipated in 2016. Construction is slated to begin in 2012.	Upgrader	
	Phase 2	78,000	TBD	Approved		Upgrader	
<b>SYNCRUDE</b>							
Mildred Lake	Stages 1 and 2	290,700	1978	Operating	Syncrude plans to increase production by constructing two 100,000-barrel-per-day mine trains at Aurora and accessing latent upgrading capacity. First new production is anticipated in 2016. Construction is slated to begin in 2012.	Upgrader	
	Stage 3 Expansion	116,300	2006	Operating		Upgrader	
	Stage 3 Debottleneck	46,500	TBD	Announced		Upgrader	
	Stage 4 Expansion	139,500	TBD	Announced		Upgrader	
<b>VALUE CREATION</b>							
Terre de Grace Upgrader	Phase 1	2,000	TBD	Application	Project partner Marathon Oil reports Expansion 1 is on track and anticipated to begin mining operations in the second half of 2010, and upgrader operations in late 2010 or early 2011.	Upgrader	
	Phase 2	10,000	TBD	Application		Upgrader	
<b>INDUSTRIAL HEARTLAND REGION – UPGRADING</b>							
<b>ATHABASCA OIL SANDS PROJECT</b>							
Scotford Upgrader 1	Expansion	155,000	2003	Operating	Shell will reportedly slow oil sands investments in favour of less costly conventional resources.	Upgrader	
	Expansion	90,000	2010	Under construction		Upgrader	
Scotford Upgrader 2	Phase 1	100,000	TBD	Application	Reports are that Reliance Industries and BP are in competition to acquire Value Creation and its oil sands assets (including BA Energy).	Upgrader	
	Phase 2	100,000	TBD	Application		Upgrader	
	Phase 3	100,000	TBD	Application		Upgrader	
	Phase 4	100,000	TBD	Application		Upgrader	
<b>BA ENERGY</b>							
Heartland Upgrader	Phase 1	54,400	TBD	Approved	NWU and Canadian Natural have submitted a joint proposal to construct and operate the facility, each owning 50 per cent with NWU as the operator. The facility would capture CO <sub>2</sub> for enhanced recovery and process Alberta's royalty bitumen.	Upgrader	
	Phase 2	54,400	TBD	Approved		Upgrader	
	Phase 3	54,400	TBD	Approved		Upgrader	
<b>NORTH WEST UPGRADING</b>							
Upgrader	Phase 1	50,000	2013	Approved	Capital plans and sequencing for the next stages of Suncor's growth to be announced in Q4-2010.	Upgrader	
	Phase 2	50,000	TBD	Approved		Upgrader	
	Phase 3	50,000	TBD	Approved		Upgrader	
<b>SUNCOR ENERGY</b>							
Fort Hills Upgrader	Phase 1	165,000	TBD	Approved	Project partner Marathon Oil reports Expansion 1 is on track and anticipated to begin mining operations in the second half of 2010, and upgrader operations in late 2010 or early 2011.	Upgrader	
	Phases 2 and 3	175,000	TBD	Approved		Upgrader	
<b>STATOIL CANADA</b>							
Upgrader	Phase 1	75,000	TBD	Withdrawn	Application on hold indefinitely.	Upgrader	
	Phase 2	175,000	TBD	Withdrawn		Upgrader	
<b>TOTAL E&amp;P CANADA</b>							
Northern Lights Upgrader	Phase 1	56,600	TBD	Withdrawn	Regulatory hearing scheduled to begin in February in Fort Saskatchewan, AB.	Upgrader	
	Phase 2	56,600	TBD	Withdrawn		Upgrader	
Total Upgrader	Phase 1	150,000	TBD	Application	Regulatory hearing scheduled to begin in February in Fort Saskatchewan, AB.	Upgrader	
	Phase 2	95,000	TBD	Application		Upgrader	
	Debottlenecking	50,000	TBD	Application		Upgrader	

# Glossary of oil sands terms

## **API**

An American Petroleum Institute measure of liquid gravity. Water is 10 degrees API, and a typical light crude is from 35 to 40. Bitumen is 7.5 to 8.5.

## **Barrel**

The traditional measurement for crude oil volumes. One barrel equals 42 US gallons (159 litres). There are 6.29 barrels in one cubic metre of oil.

## **Bitumen**

Naturally occurring, viscous mixture of hydrocarbons that contains high levels of sulphur and nitrogen compounds. In its natural state, it is not recoverable at a commercial rate through a well because it is too thick to flow. Bitumen typically makes up about 10 per cent by weight of oilsand, but saturation varies.

## **Condensate**

Mixture of extremely light hydrocarbons recoverable from gas reservoirs. Condensate is also referred to as a natural gas liquid, and is used as a diluent to reduce bitumen viscosity for pipeline transportation.

## **Cyclic steam stimulation**

For several weeks, high-pressure steam is injected into the formation to soften the oilsand before being pumped to the surface for separation. The pressure created in the underground environment causes formation cracks that help move the bitumen to producing wells. After a portion of the reservoir has been saturated, the steam is turned off and the reservoir is allowed to soak for several weeks. Then the production phase brings the bitumen to the surface.

## **Density**

The heaviness of crude oil, indicating the proportion of large, carbon-rich molecules, generally measured in kilograms per cubic metre ( $\text{kg}/\text{m}^3$ ) or degrees on the American Petroleum Institute (API) gravity scale; in western Canada, oil up to 900  $\text{kg}/\text{m}^3$  is considered light to medium crude—oil above this density is deemed as heavy oil or bitumen.

## **Diluent**

see Condensate

## **Established recoverable reserves**

Reserves recoverable under current technology and present and anticipated economic conditions, plus that portion of recoverable reserves that is interpreted to exist, based on geological, geophysical, or similar information, with reasonable certainty.

## **Established reserves**

Reserves recoverable with current technology and present and anticipated economic conditions specifically proved by drilling, testing, or production, plus the portion of contiguous recoverable reserves that are interpreted to exist from geological, geophysical, or similar information with reasonable certainty.

## **Extraction**

A process, unique to the oil sands industry, which separates the bitumen from the oilsand using hot water, steam, and caustic soda.

## **Froth treatment**

The means to recover bitumen from the mixture of water, bitumen, and solids “froth” produced in hot water extraction (in mining-based recovery).

## **Gasification**

A process to partially oxidize any hydrocarbon, typically heavy residues, to a mixture of hydrogen and carbon monoxide. Can be used to produce hydrogen and various energy byproducts.

## **Greenhouse gases**

Gases commonly believed to be connected to climate change and global warming.  $\text{CO}_2$  is the most common, but greenhouse gases also include other light hydrocarbons (such as methane) and nitrous oxide.

## **Initial established reserves**

Established reserves prior to the deduction of any production.

## **Initial volume in place**

The volume calculated or interpreted to exist in a reservoir before any volume has been produced.

## **In situ**

Latin for “in place.” In situ recovery refers to various methods used to recover deeply buried bitumen deposits.

## **In situ combustion**

A displacement enhanced oil recovery method. It works by generating combustion gases (primarily CO and  $\text{CO}_2$ ) downhole, which then “pushes” the oil towards the recovery well.

## **Lease**

A legal document from the province of Alberta giving an operator the right to extract bitumen from the oilsand existing within the specified lease area. The land must be reclaimed and returned to the Crown at the end of operations.

**Muskeg**

A water-soaked layer of decaying plant material, one to three metres thick, found on top of the overburden.

**Oil Sands**

Bitumen-soaked sand, located in four geographic regions of Alberta: Athabasca, Wabasca, Cold Lake, and Peace River. The Athabasca deposit is the largest, encompassing more than 42,340 square kilometres. Total deposits of bitumen in Alberta are estimated at 1.7 trillion to 2.5 trillion barrels.

**Overburden**

A layer of sand, gravel, and shale between the surface and the underlying oil sand. Must be removed before oil sands can be mined. Overburden underlies muskeg in many places.

**Pilot plant**

Small model plant for testing processes under actual production conditions.

**Proven recoverable reserves**

Reserves that have been proven through production or testing to be recoverable with existing technology and under present economic conditions.

**Reclamation**

Returning disturbed land to a stable, biologically productive state. Reclaimed property is returned to the province of Alberta at the end of operations.

**Remaining established reserves**

Initial reserves less cumulative production.

**Royalty**

The Crown's share of production or revenue. About three quarters of Canadian crude oil is produced from lands, including the oil sands, on which the Crown holds mineral rights. The lease or permit between the developer and the Crown sets out the arrangements for sharing the risks and rewards.

**Steam assisted gravity drainage (SAGD)**

An in situ production process using two closely spaced horizontal wells, one for steam injection and the other for production of the bitumen/water emulsion.

**Synthetic crude oil**

A manufactured crude oil comprised of naphtha, distillate, and gas oil-boiling range material. Can range from high-quality, light sweet bottomless crude to heavy, sour blends.

**Tailings**

A combination of water, sand, silt, and fine clay particles that is a byproduct of removing the bitumen from the oil sand.

**Tailings settling basin**

The primary purpose of the tailings settling basin is to serve as a process vessel allowing time for tailings water to clarify and silt and clay particles to settle, so the water can be reused in extraction. The settling basin also acts as a thickener, preparing mature fine tails for final reclamation.

**Thermal recovery**

Any process by which heat energy is used to reduce the viscosity of bitumen in situ to facilitate recovery.

**Toe-to-heel air injection (THAI)**

An in situ combustion method for producing heavy oil and oil sand. In this technique, combustion starts from a vertical well, while the oil is produced from a horizontal well having its toe in close proximity to the vertical air-injection well. This production method is a modification of conventional fire flooding techniques in which the flame front from a vertical well pushes the oil to be produced from another vertical well.

**Truck-and-shovel mining**

Large electric or hydraulic shovels are used to remove the oil sand and load very large trucks. The trucks haul the oil sand to dump pockets where it is conveyed or pipelined to the extraction plant. Trucks and shovels are more economic to operate than the bucket-wheel reclaimers and draglines they have replaced at oil sand mines.

**Upgrading**

The process of converting heavy oil or bitumen into synthetic crude either through the removal of carbon (coking) or the addition of hydrogen (hydroconversion).

**Vapour extraction (VAPEX)**

VAPEX is a non-thermal recovery method that involves injecting a gaseous hydrocarbon solvent into the reservoir where it dissolves into the sludge-like oil, which becomes less viscous (or more fluid) before draining into a lower horizontal well and being extracted.

**Viscosity**

The ability of a liquid to flow. The lower the viscosity, the more easily the liquid will flow.

## CONTACTS

### Oil Sands Producers

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  - Andora Energy
  - Athabasca Oil Sands
  - Baytex Energy
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  - Connacher Oil and Gas
  - ConocoPhillips Canada
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[www.vctes.com](http://www.vctes.com)

### Associations/Organizations

- Alberta Building Trades Council
  - Alberta Chamber of Resources
  - Alberta Chambers of Commerce
  - Alberta Energy
  - Alberta Energy Research Institute
  - Alberta Environment
  - Alberta Finance and Enterprise
  - Alberta Research Council
  - Alberta's Industrial Heartland Association
  - Canadian Association of Geophysical Contractors
  - Canadian Association of Petroleum Producers
  - Canadian Heavy Oil Association
  - Canadian Oil Sands Network for Research and Development
  - Energy Resources Conservation Board
  - Lakeland Industry and Community Association
  - Natural Resources Conservation Board
  - Oil Sands Developers Group
  - Petroleum Technology Alliance Canada
- [www.albertabuildingtrades.com](http://www.albertabuildingtrades.com)  
[www.acr-alberta.com](http://www.acr-alberta.com)  
[www.abchamber.ca](http://www.abchamber.ca)  
[www.energy.gov.ab.ca](http://www.energy.gov.ab.ca)  
[www.aeri.ab.ca](http://www.aeri.ab.ca)  
[www.environment.alberta.ca](http://www.environment.alberta.ca)  
[www.finance.gov.ab.ca](http://www.finance.gov.ab.ca)  
[www.arc.ab.ca](http://www.arc.ab.ca)  
[www.industrialheartland.com](http://www.industrialheartland.com)  
[www.cagc.ca](http://www.cagc.ca)  
[www.capp.ca](http://www.capp.ca)  
[www.choa.ab.ca](http://www.choa.ab.ca)  
[www.conrad.ab.ca](http://www.conrad.ab.ca)  
[www.ercb.ca](http://www.ercb.ca)  
[www.lica.ca](http://www.lica.ca)  
[www.nrcb.gov.ab.ca](http://www.nrcb.gov.ab.ca)  
[www.oilandsdevelopers.ca](http://www.oilandsdevelopers.ca)  
[www.ptac.org](http://www.ptac.org)

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